CLAIMS

We Claim:

1. A composite core for an aluminum conductor composite core reinforced cable comprising:

    a. a plurality of fibers from at least one fiber type embedded in one or more matrix materials; and

    b. wherein the composite core is a unitary core flexible enough to be wound on a transportation wheel.

2. A composite core according to claim 1, wherein the composite core has at least 50% fiber to resin volume fraction, an operating capability above 100° C, a modulus of elasticity at or above 14 Msi, a coefficient of thermal expansion at or above –0.7 x 10^{-6} m/m/° C, and a tensile strength within the range of about 160 Ksi to about 380 Ksi.

3. A composite core according to claim 1, wherein the fiber type is selected one of carbon, Kevlar, basalt, glass, aramid, boron, ceramic, liquid crystal fibers, high performance polyethylene, carbon nanofibers, or carbon nanotubes.

4. A composite core according to claim 1, wherein the matrix material is one of a ceramic, a thermosetting resin, or a thermoplastic resin.

5. A composite core according to claim 1, wherein one or more of the fibers have a 0° orientation.

6. A composite core according to claim 1, wherein two or more of the fibers have two or more orientations.

7. A composite core according to claim 1, wherein one or more of the fibers are twisted.

8. A composite core according to claim 1, wherein one or more of the fibers are helically placed around the core.

9. A composite core according to claim 8, wherein the fibers are placed at an angle to a longitudinal axis of the composite core.

10. A composite core according to claim 1, wherein two or more of the fibers are interlaced.

11. A composite core according to claim 1, wherein two or more of the fibers are braided.

12. A composite core according to claim 1, wherein the composite core comprises a concentric core having an inner layer and at least one outer layer.

13. A composite core according to claim 12, wherein the inner layer is made from a first fiber type and at least one outer layer is made from a second fiber type.

14. A composite core according to claim 13, wherein the inner layer is made from a carbon fiber and matrix composite and the outer layer is made from a glass fiber and matrix composite.

15. A composite core according to claim 12, wherein the inner layer is a first hybridized composite.

16. A composite core according to claim 12, wherein at least one outer layer is a second hybridized composite.

17. A composite core according to claim 1, wherein the composite core comprises a first section and at least one other section.

18. A composite core according to claim 17, wherein the first section is made from a first fiber type and at least one other section is made from a second fiber type.

19. A composite core according to claim 18, wherein the first section is made from a carbon fiber and matrix composite and at least one other section is made from a glass fiber and matrix composite.

20. A composite core according to claim 17, wherein the first section is a first hybridized composite.

21. A composite core according to claim 17, wherein at least one other section is a second hybridized composite.

22. A composite core for an aluminum conductor composite core reinforced cable comprising:

a. a plurality of fibers from at least one fiber type embedded in one or more matrix materials; and

b. wherein the fiber type is selected from one of Kevlar, basalt, glass, aramid, boron, liquid crystal fibers, high performance polyethylene.

23. A composite core according to claim 22, wherein the composite core is a unitary core flexible enough to be wound on a transportation wheel.

24. A composite core according to claim 22, wherein the composite core has at least 50% fiber to resin volume fraction, an operating capability above 100° C, a modulus of elasticity at or above 14 Msi, a coefficient of thermal expansion at or above -0.7×10^{-6} m/m/° C, and a tensile strength within the range of about 160 Ksi to about 380 Ksi.

25. A composite core according to claim 22, wherein the matrix material is one of a ceramic, a thermosetting resin, or a thermoplastic resin.

26. A composite core according to claim 22, wherein one or more of the fibers are 0° orientation.

27. A composite core according to claim 22, wherein two or more of the fibers have two or more directions.

28. A composite core according to claim 22, wherein one or more of the fibers are twisted.

29. A composite core according to claim 22, wherein one or more of the fibers are helically placed around the core.

30. A composite core according to claim 29, wherein the fibers are placed at an angle to a longitudinal axis of the composite core.

31. A composite core according to claim 22, wherein two or more of the fibers are interlaced.

32. A composite core according to claim 22, wherein two or more of the fibers are braided.

33. A composite core according to claim 22, wherein the composite core comprises a concentric core having an inner layer and at least one outer layer.

34. A composite core according to claim 33, wherein the inner layer is made from a first fiber type and at least one outer layer is made from a second fiber type.

35. A composite core according to claim 34, wherein the inner layer is made from a carbon fiber and matrix composite and the outer layer is made from a glass fiber and matrix composite.

36. A composite core according to claim 33, wherein the inner layer is a first hybridized composite.

37. A composite core according to claim 33, wherein at least one outer layer is a second hybridized composite.

38. A composite core according to claim 22, wherein the composite core comprises a first section and at least one other section.

39. A composite core according to claim 38, wherein the first section is made from a first fiber type and at least one other section is made from a second fiber type.

40. A composite core according to claim 39, wherein the first section is made from a carbon fiber and matrix composite and at least one other section is made from a glass fiber and matrix composite.

41. A composite core according to claim 38, wherein the first section is a first hybridized composite.

42. A composite core according to claim 38, wherein at least one other section is a second hybridized composite.

43. A composite core for an aluminum conductor composite core reinforced cable comprising a plurality of fibers selected from two or more fiber types embedded in one or more matrix materials.

44. A composite core according to claim 43, wherein the composite core is a unitary core flexible enough to be wound on a transportation wheel.

45. A composite core according to claim 43, the composite core having at least 50% fiber to resin volume fraction and an operating capability above 100° C, a modulus of elasticity at or above 14 Msi, a coefficient of thermal expansion at or above -0.7×10^{-6} m/m/° C, and a tensile strength within the range of about 160 Ksi to about 380 Ksi.

46. A composite core according to claim 43, wherein the fiber type is one of carbon, Kevlar, basalt, glass, aramid, boron, liquid crystal fibers, high performance polyethylene, carbon nanofibers, or carbon nanotubes.

47. A composite core according to claim 43, wherein the one or more matrix materials are one of a ceramic, a thermosetting resin, or a thermoplastic resin.

48. A composite core according to claim 43, wherein one or more of the fibers are 0° orientation.

49. A composite core according to claim 43, wherein two or more of the fibers have two or more directions.

50. A composite core according to claim 43, wherein one or more of the fibers are twisted.

51. A composite core according to claim 43, wherein one or more of the fibers are helically placed around the core.

52. A composite core according to claim 51, wherein the fibers are placed at an angle to a longitudinal axis of the composite core.

53. A composite core according to claim 43, wherein two or more of the fibers are interlaced.

54. A composite core according to claim 43, wherein the composite core comprises a concentric core having an inner layer and at least one outer layer.

55. A composite core according to claim 54, wherein the inner layer is made from first fiber type and at least one outer layer is made from a second fiber type.

56. A composite core according to claim 55, wherein the inner layer is made from a carbon fiber and matrix composite and the outer layer is made from a glass fiber and matrix composite.

57. A composite core according to claim 54, wherein the inner layer is a first hybridized composite.

58. A composite core according to claim 54, wherein at least one outer layer is a second hybridized composite.

59. A composite core according to claim 43, wherein the composite core comprises a first section and at least one other section.

60. A composite core according to claim 59, wherein the first section is made from first fiber type and at least one other section is made from a second fiber type.

61. A composite core according to claim 60, wherein the first section is made from a carbon fiber and matrix composite and at least one other section is made from a glass fiber and matrix composite.

62. A composite core according to claim 59, wherein the first section is a first hybridized composite.

63. A composite core according to claim 59, wherein at least one other section is a second hybridized composite.

64. A composite core for an aluminum conductor composite core reinforced cable comprising:

a. a first layer comprising a first composite; and

b. at least one other layer comprising a second composite bundled with the first layer.

65. A composite core according to claim 64, wherein the first layer and at least one other layer are concentric.

66. A composite core according to claim 64, wherein the composite core is hybridized.

67. A composite core according to claim 66, wherein the first layer is made from a first fiber type and at least one other layer is made from a second fiber type.

68. A composite core according to claim 67, wherein the first layer is made from a carbon fiber and matrix composite and at least one other layer is made from a glass fiber and matrix composite.

69. A composite core according to claim 66, wherein the first layer is a first hybridized composite.

70. A composite core according to claim 66, wherein at least one other layer is a second hybridized composite.

71. A composite core according to claim 64, wherein said composite core comprises a hybridized concentric core having an inner carbon fiber and matrix layer and an outer glass fiber and matrix layer.

72. A composite core according to claim 64, wherein the first layer is formed with one of a ceramic, a thermosetting resin, or a thermoplastic resin.

73. A composite core according to claim 64, wherein at least one other layer is formed with one of a ceramic, a thermosetting resin, or a thermoplastic resin.

74. A composite core according to claim 64, wherein the first composite is a high-strength composite.

75. A composite core according to claim 64, wherein the second composite is a low-stiffness composite.

76. A composite core according to claim 64, wherein the first layer is a core and the at least one other layer surrounds the first layer.

77. A composite core according to claim 64, wherein the second composite is a low-stiffness composite.

78. A composite core for an aluminum conductor composite core reinforced cable comprising:

a. a first section comprising a first composite; and

b. one or more other sections comprising at least one different composite bundled with the first section.

79. A composite core according to claim 78, wherein the first composite is formed from a plurality of fibers from a first fiber type embedded in a matrix material.

80. A composite core according to claim 79, wherein the first fiber type is carbon.

81. A composite core according to claim 79, wherein the matrix material is one of a ceramic, thermosetting resin, or a thermoplastic resin.

82. A composite core according to claim 78, wherein at least one different composite is formed from a plurality of fibers from a different fiber type embedded in a matrix material.

83. A composite core according to claim 82, wherein the different fiber type is glass.

84. A composite core according to claim 82, wherein the matrix material is one of a ceramic, thermosetting resin, or a thermoplastic resin.

85. A composite core according to claim 78, wherein the first composite is a hybridized composite.

86. A composite core according to claim 78, wherein at least one of the different composites is a hybridized composite.

87. A composite core according to claim 78, wherein at least one other section forms a lumen.

88. A composite core according to claim 78, wherein the lumen is filled with a gas or a liquid.

89. A composite core according to claim 78, wherein the gas or liquid is a cooling agent to decrease the temperature of the cable.

90. An aluminum conductor composite core reinforced cable, comprising:

a. a composite core comprising a plurality of fibers from at least one fiber type embedded in one or more matrix materials; and

b. at least one layer of aluminum conductor surrounding the composite core.

91. A cable according to claim 90, wherein said at least one layer of aluminum conductor surrounding the composite core comprises a plurality of trapezoidal shaped aluminum segments wrapped around the core.

92. A cable according to claim 90, wherein a first layer of aluminum conductors is helically wrapped around the core.

93. A cable according to claim 92, wherein a next layer of aluminum conductors is helically wrapped around the core in an opposite direction from the first layer.

94. An aluminum conductor composite core reinforced cable comprising:

a. a composite core comprising a plurality of fibers selected from two or more fiber types embedded in one or more matrix materials; and

b. at least one layer of aluminum conductor surrounding the composite core.

95. A cable according to claim 94, wherein said at least one layer of aluminum conductor surrounding the composite core comprises a plurality of trapezoidal shaped aluminum segments wrapped around the core.

96. A cable according to claim 94, wherein a first layer of aluminum conductors is helically wrapped around the core.

97. A cable according to claim 96, wherein a next layer of aluminum conductors is helically wrapped around the core in an opposite direction from the first layer.

98. An aluminum conductor composite core reinforced cable comprising:

a. a composite core comprising:

i. a first layer of a high-strength composite;

ii. at least one other layer of a low-stiffness composite bundled with the first layer; and

b. at least one layer of aluminum conductor surrounding the composite core.

99. A cable according to claim 98, wherein said at least one layer of aluminum conductor surrounding the composite core comprises a plurality of trapezoidal shaped aluminum segments wrapped around the core.

100. A cable according to claim 98, wherein a first layer of aluminum conductors is helically wrapped around the core.

101. A cable according to claim 100, wherein a next layer of aluminum conductors is helically wrapped around the core in an opposite direction from the first layer.

102. An aluminum conductor composite core reinforced cable comprising:

a. a composite core comprising:

i. a first section of a first composite;

ii. at least one more section of at least one different composite bundled with the first section; and

b. at least one layer of aluminum conductor surrounding the composite core.

103. A cable according to claim 102, wherein said at least one layer of aluminum conductor surrounding the composite core comprises a plurality of trapezoidal shaped aluminum segments wrapped around the core.

104. A cable according to claim 102, wherein a first layer of aluminum conductors is helically wrapped around the core.

105. A cable according to claim 104, wherein a next layer of aluminum conductors is helically wrapped around the core in an opposite direction from the first layer.

106. A method of high-speed processing a composite core comprising the steps of:

a. providing a plurality of fiber tows;

b. guiding the fiber tows through a wet-out system filled with resin;

c. using a B-stage oven and two or more dies spaced apart to shape and compact the fiber tows; and

d. curing the composite core member.

107. A method according to claim 106, wherein at least one of the dies is a plate having a plurality of passageways wherein the orientation of passageways is determined by the desired cross section configuration of the composite core.

108. A method according to claim 106, wherein at least one of the dies is a bushing.

109. A method according to claim 106, wherein the wet-out system comprises a system to aid in wetting the fibers.

110. A method according to claim 106, wherein the wet-out system is a wet-out tank.

111. A method according to claim 106, wherein shaping and compacting the fiber tows further comprises:

a. guiding the fiber tows into a first B-stage temperature oven;

b. guiding the fiber tows into a second B-stage temperature oven comprising a plurality of bushings wherein each bushing comprises a plurality of passageways;

c. guiding the fiber tows through the bushings and the passageways; and

d. using the bushings to form the composite core.

112. A method according to claim 111, wherein the first B-stage temperature oven is in the range of about 150° F to about 350° F.

113. A method according to claim 111, wherein the second B-stage temperature oven is in the range of about 150° F to about 350° F.

114. A method according to claim 106, wherein the step of curing the composite core further comprises:

a. guiding the composite core through a curing oven wherein a temperature of the curing oven is in the range of about 300° F to about 400° F;

b. guiding the composite core through a cooling zone wherein a temperature of the cooling zone is in the range of about 30° F to about 100° F;

c. guiding the composite core through a post-cure oven wherein a temperature of the post-cure oven is in the range of about 300° F to about 400° F; and

d. guiding the composite core through a cooling zone wherein the core is cooled by air to bring a temperature of the core into the range of about 120° F to about 180° F.

115. A method according to claim 106, wherein the method of processing has a maximum processing speed above 6 ft/min.

116. A method according to claim 115, wherein the maximum processing speed is within the range of about 9 ft/min to about 60 ft/min.

117. An electrical power transmission system, having a plurality of cables, wherein at least one cable is an aluminum conductor composite core reinforced cable comprising:

a. a composite core comprising a plurality of fibers from at least one fiber type embedded in one or more matrix materials; and

b. at least one layer of aluminum conductor surrounding the composite core.

118. An electrical power transmission system according to claim 117, wherein the composite core comprises:

a. a first layer of a first composite; and

b. at least one other layer of a different composite bundled with the first layer.

119. An electrical power transmission system according to claim 117, wherein the composite core comprises:

a. a first section of a first composite; and

b. at least one other section of a different composite bundled with the first section.

120. A method of constructing an aluminum conductor composite core reinforced cable, comprising:

a. providing a composite core comprising a plurality of fibers from at least one fiber type embedded in at least one matrix material; and

b. wrapping at least one layer of aluminum conductor around the composite core.

121. An aluminum conductor composite core reinforced cable, comprising:

a. a composite core;

b. at least one layer of aluminum conductor surrounding the composite core; and

c. wherein an ampacity of the cable is 1% to 200% greater than an aluminum conductor steel reinforced (ACSR) cable of a same outside diameter.

122. A composite core an aluminum conductor composite core reinforced cable comprising:

a. a plurality of fibers from at least one fiber type embedded in one or more matrix materials;

b. wherein said fibers for a first portion of fibers and a second portion of fibers; and

c. wherein the first portion of fibers has a first orientation and the second portion of fibers has a second orientation, and the first orientation is different from the second orientation.

123. A composite core according to claim 122, wherein the first portion of fibers is one of unidirectional, multidirectional, interlaced, woven, or braided.

124. A composite core according to claim 122, wherein the second portion of fibers is one of unidirectional, multidirectional, twisted, interlaced, woven, or braided.

125. A composite core according to claim 122, wherein the first orientation is one of 0° orientation or helically placed.

126. A composite core according to claim 122, wherein the second orientation is one of 0° orientation or helically placed.

127. A composite core according to claim 122, wherein the composite core can be wound on a transportation wheel.

128. A composite core according to claim 122, wherein the first portion of fibers is a first fiber type and the second portion of fibers is a second fiber type.

129. A composite core according to claim 122, wherein the first fiber type or the second fiber type is one of carbon, Kevlar, basalt, glass, aramid, boron, liquid crystal fibers, high performance polyethylene, carbon nanofibers, or carbon nanotubes.

130. A composite core for an aluminum conductor composite core reinforced cable comprising:

a. a first layer comprising a carbon fiber and matrix composite; and

b. at least one other layer comprising a glass fiber and matrix composite bundled with the first layer.

131. A composite core according to claim 130, wherein the first layer has at least 50% fiber to resin volume fraction, a modulus of elasticity within the range of about 22 Msi to 37 Msi, a coefficient of thermal expansion within the range of about -0.7×10^{-6} m/m/° C to about 0 m/m/° C, and a tensile strength within the range of about 160 Ksi to about 370 Ksi.

132. A composite core according to claim 130, wherein the first layer and at least one other layer are concentric.

133. A composite core according to claim 130, wherein the composite core has an operating capability above 100° C.

134. A composite core for an aluminum conductor composite core reinforced cable comprising:

a. a first section comprising a carbon fiber and matrix composite; and

b. at least one other section comprising a glass fiber and matrix composite bundled with the first layer.

135. A composite core according to claim 134, wherein the first section has at least 50% fiber to resin volume fraction, an operating capability above 100° C, a modulus of elasticity at or above 14 Msi, a coefficient of thermal expansion at or above -0.7×10^{-6} m/m/° C, and a tensile strength within the range of about 160 Ksi to about 380 Ksi.

136. A composite core according to claim 134, wherein the composite core has an operating temperature capability above 100° C.

137. A composite core for an aluminum conductor composite core reinforced cable comprising a plurality of fibers selected from a fiber class wherein the composite core includes two or more fiber types from the fiber class embedded in one or more matrix materials.

138. A composite core according to claim 137, wherein the fiber class is one of carbon, Kevlar, basalt, glass, aramid, boron, liquid crystal fibers, high performance polyethylene, carbon nanofibers, or carbon nanotubes.

139. A composite core according to claim 137, wherein the composite core is a unitary core flexible enough to be wound on a transportation wheel.

140. A composite core according to claim 137, the composite core having at least 50% fiber to resin volume fraction and an operating capability above 100° C, a modulus of elasticity at or above 14 Msi, a coefficient of thermal expansion at or above -0.7×10^{-6} m/m/° C, and a tensile strength within the range of about 160 Ksi to about 380 Ksi.

141. A composite core according to claim 137, wherein the one or more matrix materials are one of a ceramic, a thermosetting resin, or a thermoplastic resin.

142. A composite core according to claim 137, wherein one or more of the fibers are 0° orientation.

143. A composite core according to claim 137, wherein one or more of the fibers are twisted.

144. A composite core according to claim 137, wherein one or more of the fibers are helically placed around the core.

145. A composite core according to claim 144, wherein the fibers are placed at an angle to a longitudinal axis of the composite core.

146. A composite core according to claim 137, wherein two or more of the fibers are interlaced.

147. A composite core according to claim 137, wherein the composite core comprises a concentric core having an inner layer and at least one outer layer.

148. A composite core according to claim 147, wherein the inner layer is made from first fiber type and at least one outer layer is made from a second fiber type.

149. A composite core according to claim 148, wherein the inner layer is made from a carbon fiber and matrix composite and the outer layer is made from a glass fiber and matrix composite.

150. A composite core according to claim 147, wherein the inner layer is a first hybridized composite.

151. A composite core according to claim 147, wherein at least one outer layer is a second hybridized composite.

152. A composite core according to claim 137, wherein the composite core comprises a first section and at least one other section.

153. A composite core according to claim 152, wherein the first section is made from first fiber type and at least one other section is made from a second fiber type.

154. A composite core according to claim 153, wherein the first section is made from a carbon fiber and matrix composite and at least one other section is made from a glass fiber and matrix composite.

155. A composite core according to claim 152, wherein the first section is a first hybridized composite.

156. A composite core according to claim 152, wherein at least one other section is a second hybridized composite.